G.P.S. use in EHV and HVDC Transmission Line Protection

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Abstract— **This paper presents a new technique G.P.S. (global positioning system) for EHV and HVDC transmission line protection. In this scheme, the relay restrains a fault transient detection system relay together with a communication system such as SCADA system. Relays are located at each bus bar in a transmission line network. These relay detect the fault and generated high transient signals and trace the time instant corresponding to different fault occurs at bus bar and it generate initial travelling wave. Communication system SCADA is use to transmit and received digital signal of the local information and also from relays in the system .this paper provide how to use global positioning system for fast detection of the fault and solved it.**

Keywords- Global Positioning System; Possible Cause of fault, travelling wave; transmission line protectio.

I. INTRODUCTION

In recent day , It very important to fulfill the requirement of load without any fault provide a bulk power from sending end to receiving end in short duration of time. If fault occurs anywhere in between generation to load ,to find out this fault it take more time and increase the cost of transportation and number of men. Faults detected for line are very costly and can be inconclusive. In power transmission systems Accurate location of faults not only save the time but also save different resources for the electricity.. Power system operator needs accurate information acquired speedily in a form most useful to the communicating with field personnel The intro Traditional method such as as time graded over current protection ,current graded over current protection ,Distance protection to solved this problem but we have to achieve this accuracy, for this purpose a complete system of fault location technology, software system , communications system such as SCADA and power line carrier communication (PLCC) ,hardware system can be designed. Now latest available Technology i.e.GPS which can help prescribe fault location on power transmission system to within a transmission span at about 300 m. Self monitoring hardware can be configured for foundation sites with varying both condition i.e. geographic as well as environmental conditions. Communications systems can rescue fault location information from substations and immediately provide that information to power system operators. Other communication systems, such as Data Acquisition Supervisory Control (SCADA), operate fault separates the circuit breakers and turns either ON or OFF remotely and provide a means of fast reparation. For fault location selection and verification use Data from SCADA, such as oscillographs, relays and sequence of events. By using central computer software it collect fault information and also reduce operator response time for this purpose only the concise information desire for field personnel communications. “Distance to fault” from end of transmission line which lay down by Fault location systems . Field personnel can utilize this data to allocate the fault locations from transmission line drawing and map. By inserting the information in a fault location (GIS) Geographical Information System computer, Some utilities have adopted this process. It is taking large efforts by including transmission line data to the computer, so some utilities have further pare the process by using transmission structures location database. Several utilities at the latest developed these databases for transmission inventory using Global Positioning System location technology also handheld computers.

Figure 1. Transmission line

II. ELECTRICAL POWER SYSTEM

An electrical power system is a mechanism of electrical components used to supply, transmit and distribute electric power. Electric power system is the example of the network that supplies a various region's houses and industries with power - for huge regions, this power system is known as the grid and can be broadly divided into the generators that supply the power, the transmission system that transmit the power from the generating centers to the load centers and the distribution system that distribute the power to nearby industries and houses. Minor power systems are also work in

commercial buildings, industry, homes and hospitals. The many power systems depend on three-phase AC power the standard for large-scale power distribution and transmission across the recent world. Unique power systems that do not always depend upon three-phase AC power are flow out in aircraft, automobiles, and electric rail systems. Power system consists of component needed for generation, transmission, and large scale of distribution of electrical system from Hugh complex system is called power system. Power system consists of component such as generator, transformer, transmission line and load. . Electric power transmission system , is an process in the dealing of electricity to consumers, that transfer the bulk amount of electrical power. Typically, power flow from the power plant to substation. Department of distribution is the dispensation electricity from the substation to the customer. Transmission of electric power allow different energy sources (such as hydroelectric power plants,) to be connected to consumers end user utility to load centers, and may assent absorption of low-grade fuel rescue electrical power transmission normally takes place. For long distance Electricity is usually transmitted through overhead power transmission lines. Due to maintenance and high cost of installation in density populated areas. Underground power transmission is used and the high reactive power not only produces large charging currents but also difficulties in voltage management. Sometime power transmission system is referred to as a "grid"; however, for the economy reason, the network is not a mathematical grid. Line and Redundant paths are provided that power which can be routed from any power plant to any load center, through a variety of routes, based on power cost the economics of the transmission path. Dissection of transmission department find the maximum reliable caring capacity of each line, By considering system stability it, is less than thermal limit.

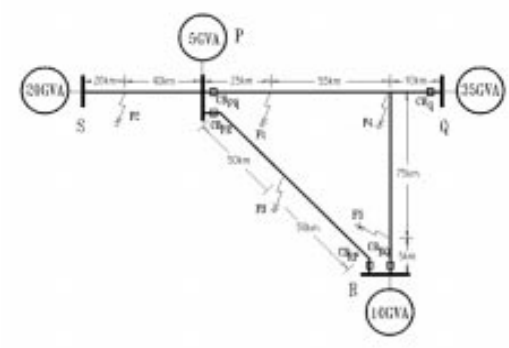

Figure 2. 400 kv EHV transmission network[1]

III. WHAT IS TRAVELLING WAVE FAULT LOCATION AND ITS BENEFITS

Difference in line ends and wave velocity also calculation of time and collection of data is done at a master station. The available information polling time at Master station should be fast needs to have system operator In power transmission system if fault is occurs ,that initiate transients which broadcast along the transmission line as waves. Each propagated wave is a conjoined of frequencies, having rang in between few kilohertz to several megahertz, having a fast increase front and a slower decaying tail. Increase waves have a T characteristic impedance and propagation velocity and travel nearly equal to the speed of light away from the fault location by line ends. Due to reflection wave and impendence, they continually travel everywhere in power system until they subtract and reached a new power system equilibrium. The fault location is proficient by exactly time-tagging wave fronts, at line end also they sloping a known point in substations. Fault location accuracy (300m.) can be gain via waves time tagged to sub microsecond resolution of 30 m.. Fault location can be calculated by multiplying the time.

In pulsed radar system, fault locators is used. By utilizing reflected radar energy, fault locators determine the fault location. Generally mobile is used as Radar equipment and located at substations and also requires manual operation. For permanent faults location fault locators technique is more famous in cable section, when the cable is de-energized. In transmission line Impedance-based fault locators are more popular for fault locating. They provide different advance algorithm that correct for load current inaccuracies and fault resistance. For single-ended locators as well as 1-2% for two-ended locator systems Line length accuracies of ±5%. For higher accuracy Traveling wave fault locators are become more popular is, high voltage direct current (HVDC), Long transmission lines, difficult accessibility lines and series-compensated lines are popular applications. By this technique Accuracies less than 300 meters can be obtain on 500 kV transmission lines. GPS-based sub developed by Hewlett-Packard. In GPS based sub system he had proved that reliable in several utility traveling wave projects. This low-cost system as well as microsecond timing system are can also be used in substation master clock.

IV. POSSIBLE COUSESS OF FAULT ON TRANSMISSION LINE

(a)

(b)


(c)


(d)

Figure 3. (a) Lighting stroke on transmission line (b) Icing on transmission line (c) Short circuit transmission line (d) Deformation and accident on transmission line

V. G.P.S. AND ITS WORKING

The global positioning system (GPS) was developed by the U.S. Department of Defense (DOD) in 1970s. The Global Positioning System (GPS) is a satellite-based navigation system, in this system one orbit made up of 24 satellite.. GPS was developed for military applications, but in the 1980s, this system available for civilian use .Now GPS system is use for both military as well as civilian. In any weather conditions GPS works, everywhere in the world,(24 hours a day). GPS Technology exactly use to determination of location, time velocity and direction. Space-based radio positioning systems (GPS) that provide three-dimensional position time and velocity information to users anywhere on the surface of the earth. In 1957, when SPUTNIC was launch then Concept of satellite navigation was first conceived by scientist. When scientists think on that, if shift frequency is measure in the small bleeps emanating from this first space vehicle it was possible to locate any point on the earth's surface. Before this realization US Department of Defense operate The NAVSTAR system, such system widely available to civilian users. Similarly in Russia, , GLONASS system is use which is similar in operation and also prove complimentary to the NAVSTAR system. Now three dimensional differential position can be determined by using GPS system also determine velocity and time. The combination of future mapping technique and current available GPS technique is used to manage natural available resources.

Signal information to earth transmitted by using 24 GPS satellite which are place in one orbit .Also GPS satellite circle the earth twice a day in a very appropriate orbit and transmit. GPS receivers received this information and utilize triangulation to calculate the user's exact location. In reality, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference express the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and show it on the unit's electronic map. By knowing the distance from another satellite, the possible positions of the location are narrowed down to two points (Two intersecting circles have two points in common). A GPS receiver must be locked on to the signal of at least three satellites to calculate a 2D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can prescribe the user's 3D position (latitude, longitude and altitude). Once the user's position has been determined, the GPS unit can calculate other information, such as speed, bearing, track, trip distance, distance to destination, sunrise and sunset time and more. Accurate 3-D measurements need four satellites. To achieve 3-D real time measurements, the receivers need at least four channels

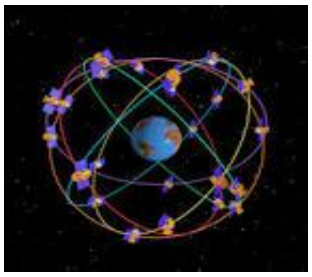


Figure 4. G. P. S. and its working

VI. G.P.S. SATTELITE NAVIGATION SYSTEM IMPLEMENTATION AND TESTING

The 24 satellites that accomplish the GPS space segment are orbiting the earth about 12,000 miles above us. They are incessantly moving, making two complete orbits in less than 24 hours. Traveling speed of this satellite roughly 7,000 miles an hour. Power supply to GPS satellites by using solar energy. They have backup batteries on board to keep them running in the event of a solar eclipse, when there's no solar power. Small rocket boosters on each satellite keep them flying in the correct path. Here are some other interesting facts about the GPS satellites (also called NAVSTAR, the official U.S. Department of Defense name for GPS): The first GPS satellite was launched in 1978. A full constellation of 24 satellites was achieved in 1994. Each satellite is built to last about 10 years. Replacements are constantly being built and launched into orbit. A GPS satellite weighs approximately 2,000 pounds and is about 17 feet across with the solar panels extended. Transmitter power is only 50 watts or less. Evaluation of the fault locator involved the installation of GPS timing receivers at four 500kV substations, .The transmission line connected to Fault Transient Interface Unit (FTIU) and discriminates for a valid traveling wave. The Fault transient interface unit produces a TTL-level trigger pulse that is coincident with the traveling wave leading edge. Under the GPS receiver manufacturer .provide A time-tagging input function. This time tagging input function accepts the TTL level logic pulse from the Fault transient interface unit and time tags the arrival of the fault-generated traveling wave. The accuracy of time tag

function is 300 nanoseconds of UTC. – Fig shows Fault Locator Installations and Testing.

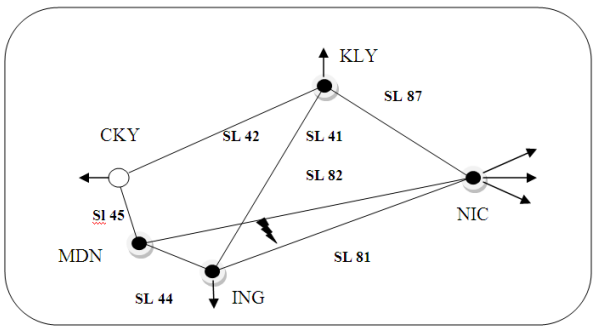

Figure 5. Fault locator Installation and Testing

A. *Fault Locator System Test*

Calculated cumulative arc length from NIC substation to the fault = 13 1,694.5 meters. Fault Locator Difference Output from Est. Value .This equation Denotes stations with travelling wave detector installations.

TABLE I. INSTALLATION PARAMETERS

Meters	TEST	Meters
1	131.725	30
2	131.819	124
3	131.721	26
4	131.803	108
5	131.800	105
6	131.834	139
7	131.730	35
8	131.697	2
9	131,829	134
10	131.806	111
11	131.810	115
12	131.814	119

TABLE II. FAULT LOCATOR RESPONSE TO TRAVELING WAVES GENERATED BY ROUTINE SWITCHING OF SUBSTATION EQUIPMENT

Line Estimated Tp(μ sec)	Measured Tp(μ sec)
501	499
66	67
805	851
900	896
901	901

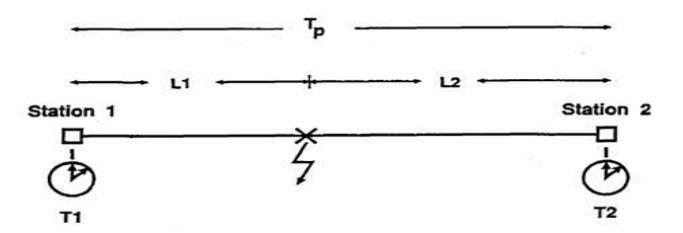

Figure 6. Distance Between terminals

The distance to the fault from the line terminals is given by:

$$L2 = \frac{Tp + \Delta T}{2} \times Vp \quad and \quad L1 = \frac{Tp - \Delta T}{2} \times Vp$$

Where Vp is the velocity of propagation for the Line,

$$\Delta T = T2 - T1$$

This equation Denotes stations with travelling wave detector installations.

VII. G.P.S. SIGNAL, ACCURACY AND ERROR

In global positioning system, two low power radio signals transmitted by using GPS satellites, we have to say L1 and L2. For L1 Civilian GPS uses the frequency of 1575.42 MHz in the UHF band. The signals passage by line of sight, they will permit through clouds, glass and plastic but will not go through most solid objects such as buildings and mountains. A GPS signal restrain three different bits of information — a pseudo ran almanac data doom code, ephemeris data and. The pseudorandom code is simply an I.D. code that identifies which satellite is transmitting information. You can view this number on your GPS unit's satellite page, as it identifies which satellites it's receiving. Ephemeris data tells the GPS receiver where each GPS satellite should be at any time throughout the day. Each satellite transmits ephemeris data showing the orbital information for that satellite and for every other satellite in the system. Almanac data, which is constantly transmitted by each satellite, contains important information about the status of the satellite (healthy or unhealthy), current date and time. This part of the signal is important for determining a position.

Due to parallel multi-channel design of GPS receiver it is extremely indurations in operating day. There are 12 parallel channel receivers are accelerated to lock onto satellites when first turned on also they maintain strong locks, even in dense foliage or urban settings with tall buildings. Few atmospheric factors such as stormy climate condition as well as other sources of imperfection such a ionosphere and troposphere delay, signal multipath, more satellite visible, can possess the accuracy of GPS receivers. The purity of GPS receiver's inside15 meters on average. Newer GPS receivers with wass (Wide Area Augmentation System) capability can reform accuracy to less than three meters on average. Due to benefit of WASS system No extra equipment or fees are required. Users can also obtain the better accuracy with within an average of three to five meters by using (DGPS) Differential Global Positioning system , which allows corrects GPS signals . The U.S. Coast Guard serves the most common Differential global positioning system correction service. This system design of a towers mechanism that receives GPS signals and transmit a corrected signal with the help of beacon transmitters. For received more accurate signal, users must have utilize a

differential beacon receiver also beacon antenna in join to their global positioning system (GPS). Due to Ionosphere and troposphere delays, the satellite signal slows when it passes through the atmosphere. Due to Signal multipath this increases the travel time of the signal thereby causing the error. some receiver's built-in clock is not as accurate due to this receiver clock errors occurs. The more satellites a GPS receiver gives the better accuracy, but due to electronic interference, causing position errors.

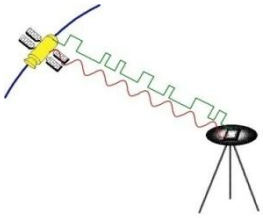

Figure 7. G.P.S.signal

VIII. CONCLUSION

A modern technique for protection of transmission line by using global positioning system (GPS). GPS plays an important role in electrical power system for both EHV transmission as well as HVDC transmission. In EHV AC transmission system, the interconnection of AC grid through AC tie line increase the fault level, this fault level will be decrease by using G.P.S. From future point of view All the aspect of characteristic and operation of EHV line is applicable to UHV transmission and protection of UHV also possible. GPS technology use integration of GPS receivers into PDA's cameras ,sports equipment and it implemented all over the world as well as in India and from protection point of view it clear the fault location from sending end to receiving end instantly, which is spare valuable time and decrease cost.GPS are use in industry ,civil engineering application , forestry and natural resources. Different traditional protection system such as time graded over current protection ,current graded over current protection ,Distance protection, this (GPS) technique provide a new concept in transmission line as well as network protection. Prior to this technology if fault occurs in between generation to load for explore fault location on long transmission line , it take more time and increase the cost of transportation. Global positioning system makes it easy and supply fast electrical service to consumer and end user utility.

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